REPLACED BY ART 34 AMDT

What is claimed is:

1. A microreactor for investigation of material reactions and properties, the microreactor comprising:

   a core body defining a chamber adapted to contain one or more sample materials and having a fluid passageway from the chamber to the exterior of the core body; and

   one or more controllable fluid supplies that can communicate with the fluid passageway and being adapted to supply one or more fluids to the chamber under controlled conditions.

2. The microreactor according to claim 1 wherein the one or more fluid supplies are adapted to supply one or more fluids to the chamber at a pressure in a range from about 0 psi to about 4,500 psi.

3. The microreactor according to claim 1 further comprising a heater adapted to heat the chamber.

4. The microreactor according to claim 3 wherein the heater is adapted to heat the chamber to a temperature in a range from about 20°C to about 400°C.

5. The microreactor according to claim 1 wherein at least one of the one or more fluid supplies is coupled to the fluid passageway using a high-pressure fitting.

6. The microreactor according to claim 1 wherein the chamber is visible through a transparent or translucent window in the body.

7. The microreactor according to claim 1 further comprising a first window adapted to allow transmission of a probe beam into the chamber and to allow observation of the chamber.

8. The microreactor according to claim 7 further comprising a second window adapted to allow transmission of the probe beam out of the chamber and enhance observation of the chamber.

9. The microreactor according to claim 7 wherein at least one of the windows comprises moissanite.

10. The microreactor according to claim 7 wherein at least one of the window comprises sapphire.

11. The microreactor according to claim 1 wherein the chamber has a volume of about 0.1 ml or more.

12. The microreactor according to claim 1 wherein the core body includes a well disposed within the core body without penetrating the chamber and having an opening to the exterior of the core body, whereby a temperature sensor can be inserted into the core body near the chamber to allow an accurate reading of temperature of the microreactor.

REPLACED BY ART 34 AMDT

13. The microreactor according to claim 1 further comprising a temperature sensor adapted to measure temperature of the chamber.

14. The microreactor according to claim 13 wherein the temperature sensor comprises a thermocouple positioned in the core body near the chamber.

15. The microreactor according to claim 1 wherein the core body comprises a corrosion resistant material.

16. The microreactor according to claim 1 wherein the core body comprises metal.

17. The microreactor according to claim 1 wherein the core body comprises Hastelloy C-276.

18. The microreactor according to claim 1 wherein the core body comprises a non-ferrous material.

19. The microreactor according to claim 1 wherein the core body comprises Be-doped copper.

20. The microreactor according to claim 1 wherein the core body includes an access opening for placing a sample in the chamber and removing the sample from the chamber.

21. The microreactor according to claim 1 further comprising a sample holder disposed within the chamber and adapted to hold one or more solid samples.

22. The microreactor according to claim 21 wherein the sample holder comprises a corrosion-resistant material.

23. The microreactor according to claim 21 wherein the sample holder comprises a material that allows transmission of a probe beam through the sample holder and allows visual observation of the sample.

24. The microreactor according to claim 21 wherein the sample holder comprises moissanite or sapphire.

25. A method of investigating the reaction or properties of materials *in situ*, the method comprising:

providing a microreactor comprising:

a core body defining a chamber adapted to hold one or more sample materials; and

a fluid passageway in communication with the chamber and adapted to be coupled with one or more fluid supplies;

placing the one or more sample materials into the chamber;

sealing the chamber;

REPLACED BY ART 34 AMDT

evacuating the chamber to remove unwanted gases and fluids;

coupling a supply of a fluid to the fluid passageway;

supplying one or more fluids to the chamber under controlled conditions; and

observing a reaction or properties of the one or more sample materials and the one or more fluids.

26. The method according to claim 25 wherein the step of supplying a fluid to the chamber under controlled conditions comprises supplying fluid to the chamber at a pressure in a range from about 0 psi to about 4,500 psi.

27. The method according to claim 25 further comprising heating the chamber.

28. The method according to claim 27 wherein the step of heating the chamber comprises heating the chamber to a temperature in a range from about 20°C to about 400°C.

29. The method according to claim 25 wherein the step of observing the reaction or properties comprises viewing or probing the chamber through a window in the body.

30. The method according to claim 25 wherein the step of observing the reaction or properties comprises transmitting a probe beam into the chamber through a first window adapted to allow transmission of the probe beam through the window.

31. The method according to claim 30 wherein the step of observing the reaction or properties further comprises detecting the probe beam through the first or a second window.

32. The method according to claim 31 wherein the probe beam comprises an X-ray beam.

33. The method according to claim 31 wherein the probe beam comprises infrared light.

34. The method according to claim 31 wherein the step of observing the reaction or properties utilizes Raman spectroscopy with laser illumination.

35. The method according to claim 31 wherein the step of observing the reaction or properties utilizes neutron spectroscopy with a beam of collimated thermal neutrons.

36. The method according to claim 25 wherein the step of observing the reaction or properties utilizes NMR spectroscopy.

37. The method according to claim 25 wherein the step of supplying a fluid to the chamber under controlled conditions comprises supplying the fluid to the chamber under a controlled temperature.

38. The method according to claim 25 wherein the step of supplying a fluid to the chamber under controlled conditions comprises supplying the fluid to the chamber under a controlled pressure.

39. The method according to claim 25 wherein the step of supplying fluid to the chamber under controlled conditions comprises supplying fluid to the chamber in a controlled amount.

40. The method according to claim 25 wherein the step of supplying fluid to the chamber under controlled conditions comprises supplying fluid to the chamber with a controlled activity.

41. The method according to claim 25 wherein the step of supplying a fluid comprises supplying a fluid in a supercritical fluid state.

42. The method according to claim 25 wherein the step of supplying a fluid comprises supplying a fluid in a liquid-rich phase.

43. The method according to claim 25 wherein the step of supplying a fluid comprises supplying a fluid in a gas-rich phase.